APPENDIX J

LATERAL PRESSURES DUE TO COMPACTION

J-1. Design pressure envelope. The design pressure envelope for nonyielding walls with compaction effects will be derived. The lateral pressure due to at-rest conditions is shown in Figure J-1.

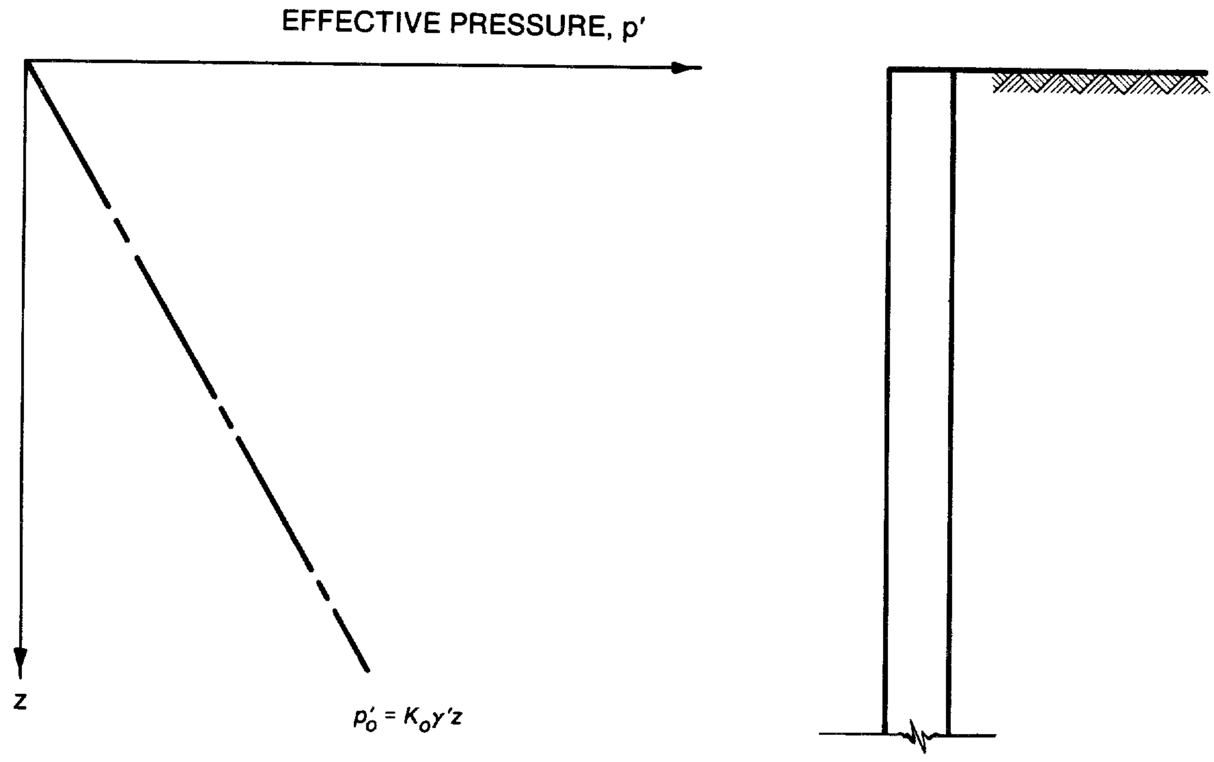


Figure J-1. Lateral pressure due to at-rest conditions ($\gamma' = \gamma$ above water table).

The lateral pressure induced by a compaction roller line load is shown in Figure J-2.

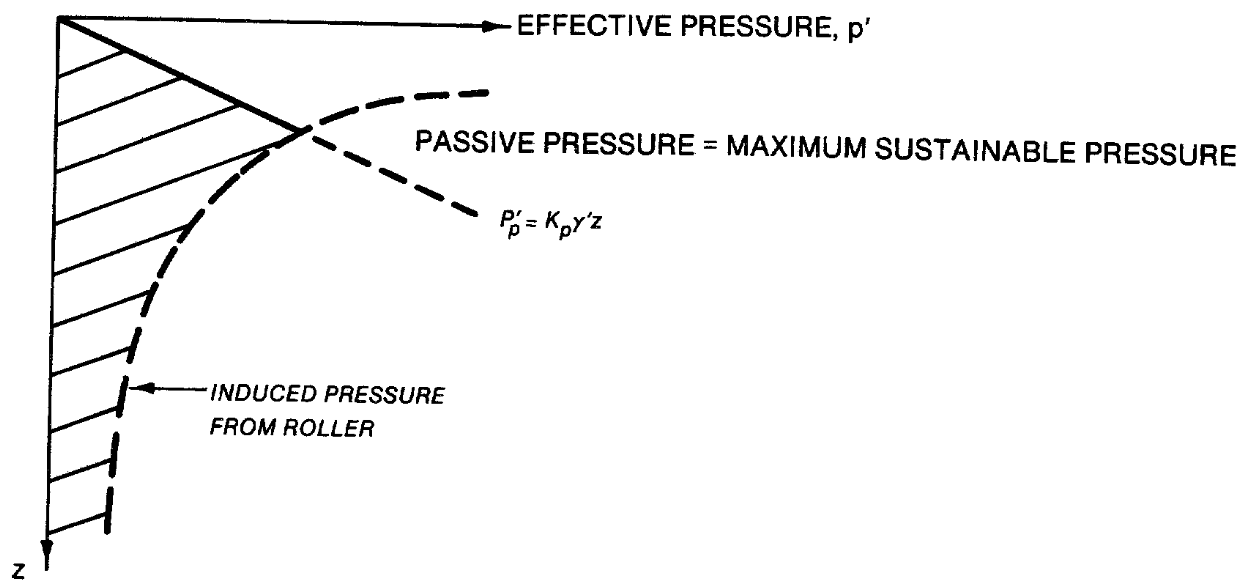


Figure J-2. Lateral pressure induced by compaction roller line load.

In Figure J-2,

$\Delta P'_v = \dfrac{2P}{\pi z}$ where P is the roller load, lb/linear ft

$\Delta P'_h = \dfrac{2K_o P}{\pi z}$ where P is the roller load, lb/linear ft

The maximum lateral pressure occurs at z_{cr} and the passive pressure is

$$P'_p = K_p \gamma' z \qquad [J-1]$$

Taking

$$K_p = \frac{1}{K_A}$$

and inserting this into Equation J-1 yields

$$P'_p = \frac{\gamma' z}{K_A} \qquad [J-2]$$

The horizontal pressure due to the earth and roller is

$$P_h' = K_o\gamma' z + \frac{2K_oP}{\pi z} \qquad [J-3]$$

Using Equations J-2 and J-3 and solving for the critical depth z_{cr} yields

$$\frac{\gamma' z_{cr}}{K_a} = K_o\gamma' z_{cr} + \frac{2K_oP}{\pi z_{cr}}$$

$$\gamma' z_{cr}^2 = K_AK_o\gamma' z_{cr}^2 + \frac{2K_AK_oP}{\pi}$$

$$\gamma' z_{cr}^2(1 - K_AK_o) = \frac{2K_AK_oP}{\pi}$$

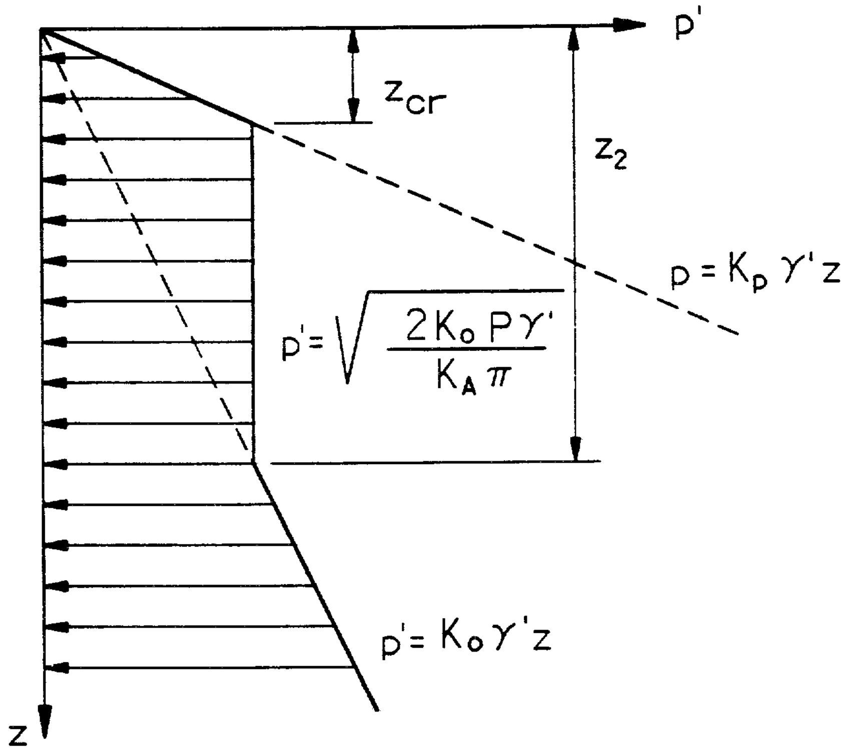
Assuming $(1 - K_AK_o) \approx 1$

$$z_{cr} = \sqrt{\frac{2K_AK_oP}{\pi\gamma'}}$$

The horizontal pressure at z_{cr} is

$$P_h' = \frac{\gamma' z_{cr}}{K_A} = \sqrt{\frac{2K_oP\gamma'}{K_A\pi}}$$

The maximum pressure is constant below z_{cr} until it is exceeded by at-rest pressure, because the foregoing analysis represents each successive top lift. The design pressure envelope for nonyielding walls including the effects of compaction is shown in Figure J-3.



$$z_{cr} = \sqrt{\frac{2K_A K_o P}{\pi \gamma}} \qquad z_2 = \sqrt{\frac{2P}{K_A K_o \pi \gamma'}}$$

Figure J-3. Design pressure envelope for nonyielding walls with compaction effects.